Simulation, analysis and design of a full aerodynamics system for a formula student race car.
Master Thesis in Aerodynamics and Product development

Background
Formula Student is the largest engineering competition in the world for students. The project is designed to increase the quality of newly examined engineers by giving them more practical experience during their studies. Teams consisting of only full time students build a race car and compete against each other. Competitions are held all over the world and teams are judged by leading engineers from the automotive industry on not only how the car performs but also how well it is engineered.

Competition results show that the importance of aerodynamics has been increasing drastically when it comes to performing well at the competitions. Generally downforce is important to increase in corners while drag reduction is of lesser importance in order to earn points on the competitions. Side wind sensitivity and car balance also have to be considered along with many other parameters when designing the aero package. Typically the package consists of front-, rear- and side wings used in combination with an undertray diffuser. Actuated systems such as a Drag Reduction System (DRS) can also be used to reduce vehicle drag on the straights. Since the aerodynamic system is quite complex, a thorough analysis is required to get the highest benefits out of it with regard to design time, cost, manufacturing time, complexity and reliability.

Task
How can powerful engineering tools such as Computational Fluid Dynamics (CFD), Finite Element Analysis (FEA) and wind tunnels be used to design a manufacturable high performance full aerodynamics system for a Formula student race car?

Different aerodynamic concepts should be evaluated and the most promising concept should be chosen for further analysis and detail design. The whole system should be analyzed, for example using CFD-tools and model scale wind tunnels to evaluate the performance that can be gained and to optimize the aerodynamic design. A manufacturable design should be created and the structural integrity should be confirmed, for example using FEA.

Additional task
There is a possibility to continue the work until the final product is finished. This will however NOT be included in the thesis, but in the formula student project. It includes the manufacturing of the whole system and testing it on the car in a full scale wind tunnel and/or on a test track where the system can be tuned and simulated performance can be verified.

Where

The work will be conducted mostly at the Formula Student office and workshop at Lund University. The result will be used by the Lund Formula Student team as a basis to build upon. The design and final product will be tested and used on the car at the competitions. Progress will be reported to the managers of the team and to the relevant supervisor.

Timeframe

The thesis workers will be part of the 2017/18 formula student team and should therefore also participate in the formula student project course (MVKN05). The work will start in september 2017 and end after the competitions in summer 2018.

As an alternative, if the thesis workers should not wish to take part in the course and do the additional task, there will be no requirement for them to stay throughout the year. In that case, the work will end in January 2018.

Qualifications

A suitable background is Mechanical Engineering or Engineering Physics. The students should have taken courses in aerodynamics and CFD. Knowledge and experience of vehicle dynamics, using FEA-software and designing/manufacturing in composites is a merit.

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